EXPERIMENTAL STUDIES IN ROTORCRAFT SYSTEM IDENTIFICATION

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September 1994

FINAL REPORT COVERING THE PERIOD
SEPTEMBER 1987 - SEPTEMBER 1990

Prepared under NASA-Ames Agreement No. NAG 2-415

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NAG 2-415: Experimental Studies in Rotorcraft System Identification

Background

This research topic addressed the use of helicopter blade-mounted instrumentation, particularly blade-mounted accelerometer sensors, in the determination of both blade motion and dynamic response due to rotor excitation from control or flight aerodynamic inputs. The work addressed the theoretical basis for this technology, its implementation issues and design approach, and conducted several experimental studies using model rotor systems directed at both studying the effectiveness of the technique and assessing its realism for application to full-size aircraft. Both the analytical work and experimental studies have been documented in a series of student theses, interim progress reports, and journal papers and conference papers over the period of the grant. The attached list documents the appropriate references to the work conducted under the sponsorship of the NASA Aeromechanics Branch at Ames Research Center, Moffett Field, California. Technical monitor for this work was Dr. Steven Jacklin; his continued support during the several years of this work is greatly appreciated.

Experimental work conducted under the support of this grant was responsible for the upgrading of the rotor test apparatus at the Princeton Longtrack (also called the Dynamic Model Track), and thus was instrumental in indirectly supporting other experimental programs that used that facility in later investigations. The laboratory was demolished in September of 1992 as part of the continued commercial development of the Forrestal Campus by Princeton University. Despite that unfortunate circumstance, the results from the experience gained in the various test programs conducted there were of considerable benefit to the current effort at the NASA Ames Center to instrument the variable stability UH-60A RASCAL aircraft with blade-mounted accelerometers for use in rotor state estimation, and in the future, rotor state feedback. The research has also helped provide the fundamentals of the methodology for supporting various instrumentation efforts directed at measuring helicopter blade motion, loads, and dynamics for the U.S. Navy.

Apart from experimental support, finds from this grant were used to help support student involvement in research activities at Princeton University in both direct and indirect ways. The various student theses and independent work projects that were related to this work, or benefitted from their use of the Longtrack laboratory, are also appended to the list of references cited below that resulted from this grant.

Bibliograph for NASA Grant NAG 2-415

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"Kinematic Observers for Active Control of Helicopter Vibration", **Vertica**, V.12, n.1/2, 1988.

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CONFERENCE PROCEEDING PAPERS

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"Model Rotor Testing at Princeton's Rotorcraft Dynamics Lab (Longtrack)", Proc. 24th Annual Subsonic Aerodynamic Testing Association Meeting, State College, Pennsylvania, June 1988.

PH.D. THESES

James E. Risser: Helicopter Rotor System Dynamics Measurement Using Blade-Mounted Instrumentation, in preparation.

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Quiang Lin: Theoretical Studies of Rotor System Identification, July 1987.

Michael Demko: High-Speed Data Acquisition for the Princeton University Dynamic Model Track, January 1988.

Andy Maraffa: Design of an Active Helicopter Control Experiment at the Princeton Rotorcraft Dynamics Laboratory, May 1989.

Michael Chih: Digital Data Acquisition System for a Gyroglider, May 1992

SENIOR THESES

Chad Pillsbury:	Servoflap Rotor Investigation
Pat Curtis:	Active Camber Control for Rotorcraft
Kim Eads:	Piezoelectric Rotorblade Tabs
Gregg Hardy:	Aeroelastic Model Design and Construction
Glenn Ward, Jeff Wilks:	NC Machining for a BERP-Tip Rotor Experiment
Tony Forkner:	High-speed Rotor Test Stand
Marty Haglund:	Shadowgraph Rotor Vortex Flow Visualization
Charlie Collins:	Shake Test of B8-M Autogiro Airframe
Mimi Rievmann:	B8-M Gyroglider Instrumentation Package
Joe Lemay:	B8-M Gyroglider Telemetry System
Mike Chih:	B8-M Gyroglider Blade Instrumentation Set